05/24/2001

1764999 - R8 SDMS

# TRANSMITTAL

2637 Midpoint Drive, Suite F, Fort Collins, CO 80525-4415 970.484.3611 970.484.4118 FAX

TO: Mark Walker
Colorado Dept of Public Health & Environment
HMWMD-RP-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1530

June 12, 2001
Date

AARCOE0103.00 23000
File Number and Location

Client Number

RE: Draft of the Proposed Initial Assessment Activities Rico Area Improvements.

**We are**

☒ Enclosing ☐ Sending Under Separate Cover ☐ As Requested

**For your**

☒ Information/Records ☐ Review ☐ Approval
☐ Action ☐ Distribution ☐ Revision and resubmittal

REMARKS:

RECEIVED
JUN 13 2001
HAZARDOUS MATERIALS AND WASTE MANAGEMENT

BY: Bill Kelly, P.E. William Kelly

c:
hg

document8 2/01

# DRAFT

**PROPOSED INITIAL ASSESSMENT ACTIVITIES**
**RICO AREA IMPROVEMENTS**
May 22, 2001

## INTRODUCTION/BACKGROUND

This proposal is prepared pursuant to a report titled "Proposed Rico Area Improvements", October 6, 2000.

### Project Setting

The project site is located near the Town of Rico in southwestern Colorado alongside the Dolores River. Site elevation at the St. Louis ponds is approximately 8,800 feet. Mean annual precipitation is about 27 inches, most of which falls as snow during fall, winter, and spring. The Town of Rico and St. Louis ponds are located in a narrow valley surrounded by mountains.

### St. Louis Pond System

The St. Louis pond system has been in existence since the 1950's. The pond system was constructed to settle waste from the local mining activities and later was used to settle solids from the St. Louis Tunnel discharge. Between 1984 and 1995, lime was added to the tunnel discharge to improve water treatment and solids removal. Since that time, lime has not been added but solids continue to be deposited in the ponds. An inventory of the pond system in 1995 showed minimal additional space remaining for solids deposition in the upper ponds.

The peak discharge from the tunnel to the pond system is estimated at approximately 2200 gpm. Peak discharges from the tunnel generally occur during late spring, are associated with snowmelt, and slightly lag the peak discharge in the Dolores River. The average annual discharge to the pond system has been estimated at 1100 gpm. Discharges from the tunnel have been measured only periodically as no permanent flow measurement is presently provided.

Overburden was excavated in the last few years from over the tunnel portal and to a distance of several hundred feet into the hill. Subsequently the tunnel has collapsed behind the portal causing the water exiting the tunnel to flow overland and/or in ditches and pipes in an uncontrolled fashion.

### Solids Management Issues

Proposed water treatment improvements at the St. Louis ponds include removal of accumulated solids from within the upper ponds of the existing pond system. Work completed in prior studies (Paser, 1996) indicated that the greatest solids accumulation is limited to the upper ponds and that the solids present in lower ponds is not significant in volume. The solids present in ponds 11 through 18 in 1996 was estimated at 1,650,000 cubic feet at a concentration of 25 percent solids. Those estimates required assumptions regarding the pond geometry and solids depth that need to be verified. Furthermore additional solids deposition has continued since that inventory which needs to be accounted for.

Future solids production rates will be a function of lime addition rates and tunnel discharge water quality. Recent monitoring has suggested that water quality exiting the tunnel may be different from that historically discharged. New estimates of lime utilization and solids production will be made as part of the proposed treatability study.

Tests for solids toxicity (TCLP) suggested that the solids in the ponds is non-hazardous. Because these tests were performed on surficial solids, additional tests will be performed to confirm the status of solids at depth.

At this time, solids disposal in an onsite area (of limited capacity) up gradient of the pond systems is proposed. Because costs for solids disposal are estimated to be significant it is important to identify the most economical method feasible. If found feasible, that method will likely be one that involves minimal solids handling and includes a non-mechanical lagoon type disposal. Issues with this type of facility that need to be addressed include the short drying season and limited open land area at the St. Louis site. Bench and/or pilot-scale tests will be undertaken to evaluate potential solids application/drying rates both assuming disposal directly in the final disposal repository and in an interim solids-dewatering pond. Evaluation of direct disposal in a final repository will be based on bench-scale solids consolidation tests to represent potential dewatering through a repository under-drain system following deep and/or repeated application of solids. Additional samples will also be tested for mechanical dewatering.

**Blaine Adit**

The Blaine adit, which is connected to the St. Louis Tunnel by cross-tunnels, is located near the Argentine tailings pond alongside Silver Creek. Minor seepage from the Blaine adit (approximately 1.5 gpm) has been observed since approximately 1996. The expired permit issued to Rico Development Corporation in 1993 prohibited discharge from the Blaine. The underground diversion to the St. Louis Tunnel and pond system is by a cofferdam located several hundred feet into the Blaine from the portal. According to a verbal report by Garry Shrewsberry with Nielsons, who entered the adit in the fall of 2000, a small pipe in the cofferdam is leaking. Shrewsberry indicated the cofferdam is of concrete construction, about five-feet high, and 8-inches thick; at the time of his inspection, water was approximately 18 inches deep on the backside of the cofferdam. Gary could not state if seepage was also occurring around the cofferdam. At the time Gary made the entrance, ventilation was adequate, with air movement inward from the portal.

**Preliminary Cost Estimates**

Preliminary cost estimates previously completed provide a significant range to accommodate uncertainties. A key cost factor involves the cost of solids management. Variables which are uncertain at this time include the quantity (both volume and density) of solids contained within the ponds, the difficulty of removing that solids from the ponds, the costs for dewatering and disposing it, and the future solids production rate.

### Monitoring

Monitoring of pond system discharge water quality will be undertaken this year during proposed activities at the St. Louis Ponds to confirm that no adverse impacts to water quality result. Existing data from prior monitoring at the Argentine Seep will be assembled and reviewed to assess impacts from the seep on Silver Creek. Additional monitoring of background water quality/flow rates will be completed at the St. Louis Ponds and at the Argentine Seep (depending on the results of the data review) to enable more complete assessment of existing conditions.

## PROJECT SCOPE

### Overview

This proposed work is primarily focused on obtaining additional information on which to base a more comprehensive cost and water quality compliance evaluation of the improvements being considered at Rico. Work is specifically proposed to: 1) identify water treatment parameters including lime requirements, solids production, and resulting dissolved metals levels at the St. Louis Ponds, 2) field survey the bottom and top of solids geometry of the existing ponds, and complete an inventory of existing solids quantities including volumes and percent solids in the St. Louis ponds, 3) obtain field information to evaluate solids removal techniques (dredging vs excavation and associated solids concentrations), and 4) obtain bench/pilot scale information to evaluate solids dewatering methods, both mechanical and non-mechanical.

Information obtained from the evaluation will be used to compare alternatives and improve the basis of the cost estimate for proposed improvements at the St. Louis Tunnel and to compare potential metals removals to that required by treatment standards being evaluated separately.

Additionally it is proposed to: 1) monitor performance of the St. Louis ponds during site work, 2) obtain additional base line data on the St. Louis tunnel discharge and water quality impacts to the Dolores River from the system, 3) obtain water quality data relative to impacts to Silver Creek from the Argentine Tailings, and 4) reinstate the physical integrity of the Blaine cofferdam.

### Task 1 - Solids Inventory

A variety of data collection activities are proposed in order to conduct a thorough inventory of existing solids in the upstream treatment ponds (Ponds 11, 12, 14, 15 and 18). The primary purpose of the inventory is to provide detailed data on existing solids volume and engineering properties (solids content, grain size, consolidation and strength properties. Information will be used as a factor in assessing removal, dewatering and repository design requirements. A secondary purpose of the inventory is to recover samples of solids for mechanical bench-scale dewatering tests described later.

The solids inventory sampling and laboratory analysis plan is presented in Table 1. The table presents a schedule of ponds sampled and number of samples for each type of test. Sampling is described below in further detail. Laboratory testing is described in subsequent sections.

**Solids-Core Sampling.** Core samples of the solids will be taken to recover additional samples for analysis. The core sampling methodology will be similar to that used in the Paser study (1996), where an approximately 3-inch ID sampler was used to push through and recover solids samples. A subcontractor experienced in this type of sampling will be used to recover and package the samples. The core will be logged for comparison to adjacent cone penetrometer soundings and bathymetry surveys. Samples recovered will be used in bench scale mechanical-dewatering tests, engineering property tests, and chemical analysis testing described later.

**Cone-Penetrometer Sounding.** During sampling of the pond solids from the boat, a portable cone penetrometer will be used to sound the depth to pond bottom and to measure the consistency of the solids. The portable cone penetrometer is steel and consists of a small cone tip connected to a moveable rod within a sleeve that registers cone tip bearing resistance on a dial gauge mounted on a hand-operated tee handle. Sections of rod and sleeve can be added, and depths up to 25' feet can be sounded. Soundings can be taken rapidly from a boat using the portable device. The primary purpose of the soundings for this application is to estimate the depth to pond bottom. A number of resistance measurements of the solids to the cone tip will be recorded. These readings can be roughly correlated to undrained strength of the solids and will serve as a relative gauge of solids consistency. Additional soundings will be taken without resistance measurements to estimate/document the depth to the bottom of solids for definition of the pond geometry and quantity estimation purposes. The results of this work will also be available for final design and construction of future improvements if these phases are subsequently implemented.

**Bathymetry Survey.** A special survey rod will be used to measure/document the depth to top of resistant solids for purposes of volume calculations. The results of this work will also be available for future bidders if full-scale solids removal/dewatering is implemented. The rod will have a 1'x1' platform at the tip which provides resistance to penetration of the soft upper layer of solids. The rod will have consistent negative buoyancy at all depths of up to ten pounds (adjustable), and be lowered under its own weight until refusal is encountered, where depth to top of solids will be recorded. The buoyancy of the rod will be adjusted to approximate the liquid / solid interface determined from core sampling.

**Surveying.** Locations of all samples and other measurements will be recorded for future reference. Local surveyors will be contracted to survey control grids for sample location. Water levels in all ponds will be recorded in addition to sample location surveys. The top of bank perimeter in the upper ponds will be located and sufficient sections will be developed to enable development of contours for both top of solids and bottom of pond

**Task 2 - Solids Removal Investigations**

**Introduction.** A major component of the proposed work involves collecting information to assess the most effective solids removal/disposal process from a total cost perspective. Two basic solids removal techniques will be studied – removal via conventional earthmoving equipment and by dredging. The proposed work will provide pilot scale demonstrations of each technique, and provide data for final design and cost estimation.

**Pond 18 Dewatering/Bypass.** The scope outlined below is contingent upon approval by the State of Colorado regarding bypass of Pond 18.

***Bypass.*** For purposes of excavability tests described below, Pond 18 will be bypassed by diverting the St. Louis Tunnel discharge to Pond 15 via a 15-inch diameter buried pipeline. An interception ditch will be excavated around and downstream of the collapsed tunnel to intercept dispersed tunnel discharge. The bypass pipeline will connect to the interception trench and route flow to Pond 15, bypassing Pond 18. The pipeline will be approximately 800-ft long, 15" diameter corrugated HDPE pipe with a design flow capacity of 4,400 gpm at a slope of 0.02 ft/ft. This capacity is significantly greater than the believed historic peak flow of 2,000 gpm and should successfully carry all anticipated flows.

***Dewatering.*** Pond 18 will be decanted by pump after the diversion is complete, and during each site visit for the duration of the field operations. Purchase of several Honda Diaphragm pumps for solids removal and dewatering service is proposed. The excavability tests described below are expected to provide a sump, which will allow water to be drawn down below the top of solids. Decant and excavability-testing procedures are described later. Prior to dewatering, solids inventory sampling described above will be conducted, and staff gauges will be installed within the pond. Decanting of the pond is expected to have a consolidation effect on the solids, for which the level will be monitored on a periodic basis by the use of staff gauges and compared to pre-dewatering measurements of solids volume. Water from the surface of Pond 18 will be pumped to Pond 15 where suspended solids can settle. Dewatering quantities will be estimated and dewatering effluent samples will be collected for metals analysis as described later. The ability to continue consolidation may, in part, depend on the influence and elevation of the surrounding groundwater. Piezometers will be placed in several test pits adjacent to Pond 18 to aid in evaluating groundwater levels/impacts. The diversion pipe will be left in place for possible use in permanent pond construction/operations.

In combination with staff gauge measurements to estimate consolidation rates, baseline solids volume data collected from the solids inventory, estimates of the volume of decant water pumped, and potential additional follow-on excavation tests, this operation could provide supplementary dewatering information and data to assess the feasibility of dewatering solids in-place prior to removal.

**Conventional Excavation.** Conventional excavation equipment will be utilized if possible to create the sump in Pond 18 from which additional water can be pumped to Pond 15 using portable solids pumps. Following a field-determined waiting period, an excavation test via conventional earthmoving equipment (CAT 245 excavator or equivalent) will be undertaken. Solids will be excavated from the shoreline (lowered as necessary to provide a suitable excavation platform). At this time, it is assumed that the pond geometry is favorable to allow a Caterpillar 245 or equivalent excavator to recover sufficient quantities of solids from shoreline. During initial site reconnaissance, a suitable point for excavation from shore will be located, and the feasibility of using an excavator from shore verified. It is assumed that the solids dewatering cells can be located close to Pond 18, and that the excavator will be used to walk the solids to some of the cells. Depending on field observations, additional excavation beyond the volume requirements of the test cells will be conducted as necessary to assess the feasibility of solids excavation, including evaluation of solids in-place and post-handling consistency. Additional solids excavated will be stockpiled onshore in an area where runoff can be directed to either Pond 15 or Pond 18.

**Dredge Filling.** Dredging will be accomplished via a small scale simulated dredging operation rather than conventional dredging equipment to minimize costs. It is assumed that existing deposited solids is primarily colloidal in size and can be pumped at field-scale solids content (approximately 10%) via temporary inexpensive portable solids pumps hooked in series (Honda WDP30X Diaphragm Pump proposed). These pumps are designed to handle solids and would be purchased and stored onsite for potential refilling the solids ponds during the life of the tests. During initial site reconnaissance, portable rod samplers will be used to collect samples for assessment of solids consistency and grain size (for use in hydraulic calculations). The pump will also be tested from shore to verify the feasibility of using the pumps during pilot scale testing.

The first pump will be mounted on a barge navigated across the pond via ropes controlled by personnel onshore. The barge constructed for ARCO for the Paser (1996) study was reportedly left onsite and will be used if possible. If the barge is unavailable, a smaller, unmanned barge will be fabricated to float the pump and control the suction line. A mechanism to control the depth of the suction line will also be added to simulate pumping at various pond depths. Attached floats within the pond will be used to support the discharge line. At least one additional pump for backup and additional lifting capability will be purchased. Depending on the final location of the test cells, and solids thickness and grain-size conditions encountered in the field, one or two additional pumps may be required to overcome friction losses.

Solids removal investigations will initially be conducted in Pond 18. Sequencing will necessitate that dredging operations be completed prior to excavation/dewatering tests which will lower the level of Pond 18. Subsequent dredge filling of test cells, if undertaken, would be conducted from within Pond 15.

**Task 3 – Solids Dewatering and Disposal Investigations**

The potential to dewater/consolidate in-pond prior to excavation will be explored under Task 2 as described previously. Additional tests of potential non-mechanical dewatering techniques will be undertaken to evaluate the feasibility of dewatering in separate dewatering cells, and/or directly in the final repository. Tests will be done on a bench scale via test columns and laboratory consolidation testing and in pilot scale dewatering cells. Evaluations will also consider feed concentration of solids as to whether it has been placed following excavation (thick concentration) or by dredge and pump (thinner concentration).

### Laboratory Consolidation Testing

Laboratory consolidation tests will be conducted on solids samples recovered from the solids coring. These samples will be reconstituted from their in-places densities and structure to simulate both excavated and pumped removal methods. The samples are then subjected to applied pressure, allowing drainage to occur over time, while compression is measured. The process is then repeated for successively higher consolidation pressures. From this data, information regarding the initial time rate of compression due to applied load, *primary consolidation* (time rate of compression from dissipation of pore pressure due to the applied load), and *secondary consolidation* (time rate of compression due to plastic deformation after dissipation of pore pressure). This information will allow various repository deposition alternatives having different applied loads and loading rates to be simulated and optimized via computer modeling in final design. The information provides both a check and backup for the results of the column and field scale tests (described below), and provides additional important information regarding the behavior of the solids due to applied load, which may be utilized in the final repository design to minimize repository volumes.

### Column Tests

Column bench-scale dewatering tests will be conducted to assist in setting up pilot-scale dewatering test cells and to provide additional range of data which may be used to extrapolate the conclusions reached through pilot-scale testing. A series of 12 4-inch diameter translucent pvc pipes, six ft long, will be set up in the field. The columns will be secured vertically, will have a sand bottom, and if possible, will be located near an existing building to limit direct sunlight and precipitation effects. The columns will be set up early in the field investigation process to enable obtaining preliminary results, which can be used to adjust the proposed pilot-scale dewatering test cell operation. The various columns will be setup with different solids feed depths, concentrations, and polymer addition. Surface water decanted, under-drainage collected, and total solids depth will be documented on each site visit. Any additional solids added to a column will also be documented. The information collected through column tests will be calibrated to pilot-scale results and, if possible, used to extrapolate pilot-scale results.

### Pilot Scale Dewatering Test Cells

To assess the feasibility and effectiveness of various options for dewatering solids, a series of four pilot scale test cells is proposed. At this time, test cells will be constructed to test only shallow dewatering techniques. The cells will consist of four four-foot high (maximum) lined earthen embankments designed to simulate solids dewatering and/or aeration of solids up to three feet in depth. A sketch of the proposed shallow cells is given in Figure 1
In conjunction with the test columns, the array of shallow cells will be used to test a variety of solids removal / sequencing and dewatering options to gain insight into the most effective technique and to aid in determining full-scale size requirements if an alternative is subsequently implemented. Variables to be tested include: 1) removal method (pump vs. excavator), 2) application depth, 3) mixing to enhance air-drying, and 4) effect of multiple applications

dewatering rates. We expect the test plan to yield information to aid in isolating effects of the three primary dewatering mechanisms, which are decanting, air-drying and consolidation/draining. The proposed test plan for each cell is summarized below:

| Cell # | Cell Depth | Cell Fill Method | Dewatering Method | Polymer/ Coagulant Added? | Specific Purpose / Comments |
|---|---|---|---|---|---|
| 1 | Shallow 36-inch | Dredge/ Pump | Initial fill / decant / underdrainage | Yes | Base line test of drying time vs. percent solids – medium application depth, single application. |
| 2 | Shallow 18-inch | Dredge/ Pump | Initial fill / decant / underdrainage – possible repeated fills | Yes | Same as Test #1 but evaluate effect of application depth. If possible, also evaluate effect of repetitive fills on consolidation and air drying |
| 3 | Shallow 36-inch | Dredge/ Pump | Initial fill / decant / underdrainage/ Mixing | Yes | For comparison to Test #1 but evaluate effect of mixing on air drying |
| 4 | Shallow 36-inch | Excavate | Initial fill / decant/ underdrain/ mixing/ Possible repeated fills | No | For comparison to Tests #1 (comparison of removal method / initial fill concentration; assess bearing capacity of consolidated tailings. |

**Cell Location.** A suitable location for the test cells will be determined during initial site reconnaissance. The ideal location is directly east of Pond 15 and immediately southeast of Pond 18 within the former Pond 16. This location provides convenient access, and low pumping head differential for solids from Pond 18 for both dredge and excavation removal option tests. The foundation of this area and grading requirements will be assessed for ability to support the test cells and construction equipment required for constructing the cells. Test-cell decant and infiltration outflows will be routed via gravity for infiltration into the former Pond 16 basin.

**Polymer/Coagulant Testing.** At this time we anticipate adding polymer to the test cells filled with pumped solids. The potential benefit of using polymer will be evaluated as part of the bench testing completed prior to implementing pilot-scale testing. We are assuming that pumped solids will be diluted and that the polymer/coagulant addition will facilitate settling and subsequent decanting, thereby speeding up the dewatering operation.

**Monitoring and Testing.** Cells will be monitored approximately every two weeks during scheduled site visits and once during each intermediate week by a local laborer. The current proposal envisions one site trip by SEH each month, using Terry McNulte, who plans on residing in Dolores during the summer, for monitoring between SEH visits (also once per month), with a local laborer present at each visit and weekly between visits. Measurements of consolidation and visual observations of each cell will be documented. Decant/underdrain effluent will be sampled for testing and water levels/flow rates measured on a periodic basis. Depending on the progress of the consolidation, cells will either be refilled if space is available, or mixed to aerate the surface using a portable rototiller when surface consistency permits. Refer to the test plan provided in the above schedule for specific details of the various cells. Actions taken will be documented. Samples for percent solids, density, and strength testing will be collected periodically and at the end of testing to assess the progress of dewatering/consolidation. Precipitation and evaporation records will be maintained as practical.

**Expected Results.** It is expected that in combination with visual observations of the solids removal operation, the results provided by the test columns, and tests cells will give a good indication of the most feasible method of solids removal and the most effective and efficient non-mechanical dewatering method for final design. The need for an intermediate mixing/drying facility will be assessed. The tests should also provide a good assessment of processing / consolidation time / area required as well as repository volume requirements for comparison of mechanical and non-mechanical dewatering options.

**Mechanical Bench-Scale Testing.** Solids samples from the existing ponds will be collected and delivered to potential dewatering contractors. Contractors are expected to complete evaluations of options for removal and dewatering and provide estimates of required costs and expected results for full-scale operations.

**Task 4 – Treatability Study**

Samples of discharge from the St. Louis tunnel interception trench will be collected and shipped to a subcontractor for treatability testing. CH2M HILL is proposed to complete the treatability testing. A separate proposal for work performed by CH2M is attached hereto. Generally, the work proposed includes: 1) preparation of a work plan and 2) bench testing and preparation of a report with recommendations for full-scale treatment. The work plan is expected to include determination of lime requirements, evaluation of the ability of lime precipitation to achieve treatment goals for dissolved metals, and evaluation of the amount of solids generated. The work will also include evaluation of solids settleability.

**Task 5 – Pilot-Scale Phase Monitoring**

Monitoring will be completed during the pilot-scale phase activities to confirm that the treatment performance of the system is not being compromised. Sampling will be completed before the work begins once/month during the pilot-scale phase. The discharge to the Dolores River will be sampled and analyzed for parameters listed in the expired permit. Additionally, the filtrate from dewatering cells will be sampled monthly and analyzed for the same parameters as the discharge to the river.

**Task 6 – Base-Line Monitoring**

Additional monitoring will be completed of the St. Louis Pond System to improve the base line understanding of loading and impact to the Dolores River. Flow measurement capability will be added to the collected discharge from the St. Louis Tunnel upstream of the bypass. Tunnel discharge flow rates will be recorded at each site visit. Samples will be collected for analysis twice during the project at the tunnel discharge, at the pond discharge, in the Dolores River above the pond system, adjacent to Pond 14, above the pond system discharge and below the pond system.

The Argentine seep will be evaluated as follows: 1) assemble and review all pertinent data previously collected with regard to the Argentine seep discharge flow rate, and chemical analysis, of the seep discharge, and Silver Creek above and below the Seep and at the Dolores River, 2) after re-diversion of the Blaine adit discharge, collect additional samples at the locations identified above while measuring the discharge of the seep and Silver Creek to establish any changes since capping of the Argentine tailings. Based on the above information calculate the theoretical impact of the seep discharge on Silver Creek,

Task 7 – Update Cost Estimate

The cost estimate for the Rico Area Improvements dated 11/10/00 will be updated where appropriate based on the information developed as part of this effort. Specific refinements are anticipated with regard to the quantity of solids to be removed from the existing ponds, the unit cost of removal and disposal, and the cost of the lime addition facilities, both capital and operation and maintenance.

Task 8 – Blaine Adit

Work at the Blaine adit assumes use of a contractor to plug the existing pipe through the concrete cofferdam, and placement of bentonite upstream of the cofferdam at its base and adjacent to its connection at the sidewalls. We have assumed this work will be completed with one day's effort.

## SCHEDULE

The anticipated schedule for completing the work outlined herein is generally as follows:

Authorization to Proceed: June 1, 2001
Authorization to Bypass Pond 18: June 15, 2001
Complete Work Plans: April – June 21, 2001
Onsite Investigations/Construction of Test Cells: June 15 - July 15, 2001
Onsite Test Cell Operations: July 15 – October 15, 2001
Treatability Studies: June 15 – August 1, 2001
Report Preparation: October 15, 2001 - November 15, 2001

DRAFT

## Table 1 - Rico / St. Louis Ponds Sampling and Testing Plan

### Sampling

Number of Sampling Locations per area

| Category | Type | Description | Purpose | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Extra | Proposed Repository Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approximate Pond Surface Area (acres): | | | | | | | | | | | | 0.5 | 0.7 | | 0.5 | 1.5 | | | 2.0 | | |
| | | Pond Depth (feet): measured in prior studies / estimated | | | | | | | 6 | | | | | 10 | 9 | | 9 | 9 | 10 | | 9 | 9 | |
| | | Sludge Depth (feet): measured in prior studies / estimated | | | | | | | 1 | | | | | 2 | 3 | | 4 | 7 | 10 | | 6 | 5 | |
| SAMPLING CATEGORIES – Sludge Inventory | Cone Penetrometer Sounding (sludge consistency) | Portable hand cone penetromer probe pushed into subsurface manually to measure penetration resistance up to 25' | Define refusal depth of sludge / pond bottom within ponds for quantity estimates; define consistency of sludge from barge/canoe | | | | | | | | | | | 3 | 4 | | 4 | 12 | | | 12 | | |
| SAMPLING CATEGORIES – Sludge Inventory | Cone Penetrometer Sounding (sludge bottom) | Portable hand cone penetromer probe pushed into subsurface manually to measure depth to bottom of sludge up to 25' | Define refusal depth of pond bottom within ponds for quantity estimates | | | | | | | | | | | 38 | 44 | | 38 | 67 | | | 78 | | |
| SAMPLING CATEGORIES – Sludge Inventory | Sludge Core Sampling | Portable core sampling equipment designed to be used from a boat to recover a core of soft pond sediments | Recovery of pond sludge solids and liquids for toxicity analysis, gradation analysis and %solids testing. | | | | | | | | | | | | 1 | | 1 | 2 | | | 2 | | |
| SAMPLING CATEGORIES – Sludge Inventory | Bathymetry Survey (sludge top) | Depth sounding to top of sludge using specialized survey rod | Bathymetry survey of ponds for revised quantity estimates | | | | | | | | | | | 38 | 44 | | 38 | 67 | | | 78 | | |
| SAMPLING CATEGORIES – Sludge Inventory | Pond surface Survey | Water Surface Survey | Pond surface elevation and perimeter | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 | 20 | 1 | 20 | 20 | 1 | 1 | 20 | | |
| SAMPLING CATEGORIES – Geotechnical | Cone Penetrometer Sounding | Portable hand cone penetromer probe pushed into subsurface manually to measure penetration resistance up to 25' | Define refusal depth of sludge / pond bottom within ponds; qualitative data on foundation quality of Pond 16 to support dewatering facility. | | | | | | | | | | | | | | | | 10 | | | | |
| SAMPLING CATEGORIES – Geotechnical | Test pits | Test pits and piezometer installation Pond 18 | Recovery of samples for testing / define depth to firm base and/or alluvium/bedrock | | | | | | | | | | | | | | | | 3 | | 3 | | |
| SAMPLING CATEGORIES – Removal / Dewatering | Pilot Scale Sludge Dewatering Tests | Removal of sludge via pumping / excavation, transfer to Pilot scale dewatering test cells; addition of polymer; mixing. | Assess most effective non-mechanical method for dewatering sludge. | | | | | | | | | | | | | | | | | | 4 | | |
| SAMPLING CATEGORIES – Removal / Dewatering | Field Scale Sludge Excavation Tests | Excavation and processing of sludge using conventional earthmoving equipment | Assess potential for excavating sludge with conventional earthmoving equipment | | | | | | | | | | | | | | | | | | 1 | | |

### Sampling (totals) and Testing

Chemical Properties: TCLP-Analyses, Metals Concentrations. Geotechnical / Engineering Properties: % Solids, Gradation, In-place Density, Consolidation, Bench Scale Mechanical Dewatering. (Number of Analyses)

| Type | Sample Location survey required? | Number of Ponds Sampled | Total number of Sampling Locations | Total Pond Depth Sampled (ft) | Total Sludge Depth Sampled (ft) | Samples per foot of depth | Total Number of Samples | TCLP-Analyses | Metals Concentrations | % Solids | Gradation | In-place Density | Consolidation | Bench Scale Mechanical Dewatering |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cone Penetrometer Sounding (sludge consistency) | Yes | 5 | 35 | 318 | 214 | 1 | 214 | - | - | - | - | - | - | - |
| Cone Penetrometer Sounding (sludge bottom) | Yes | 5 | 265 | 2423 | 1453 | - | 265 | - | - | - | - | - | - | - |
| Sludge Core Sampling | Yes | 4 | 6 | 54 | 37 | 1 | 54 | 3 | - | 18 | 6 | 18 | 18 | 2 |
| Bathymetry Survey (sludge top) | Yes | 5 | 265 | - | - | - | 265 | - | - | - | - | - | - | - |
| Pond surface Survey | Yes | 18 | 113 | - | - | - | 113 | - | - | - | - | - | - | - |
| Cone Penetrometer Sounding (Geotechnical) | Yes | 1 | 10 | 100 | 100 | 1 | 100 | - | - | - | - | - | - | - |
| Test pits | Yes | 2 | 6 | - | - | - | - | - | - | - | - | - | - | - |
| Pilot Scale Sludge Dewatering Tests | Yes | 1 | 4 | - | - | - | 4 | - | 3 | 12 | - | 12 | - | - |
| Field Scale Sludge Excavation Tests | No | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| TOTAL | | | 705 | 2895 | 1804 | | 1015 | 3 | 3 | 30 | 6 | 30 | 18 | 2 |

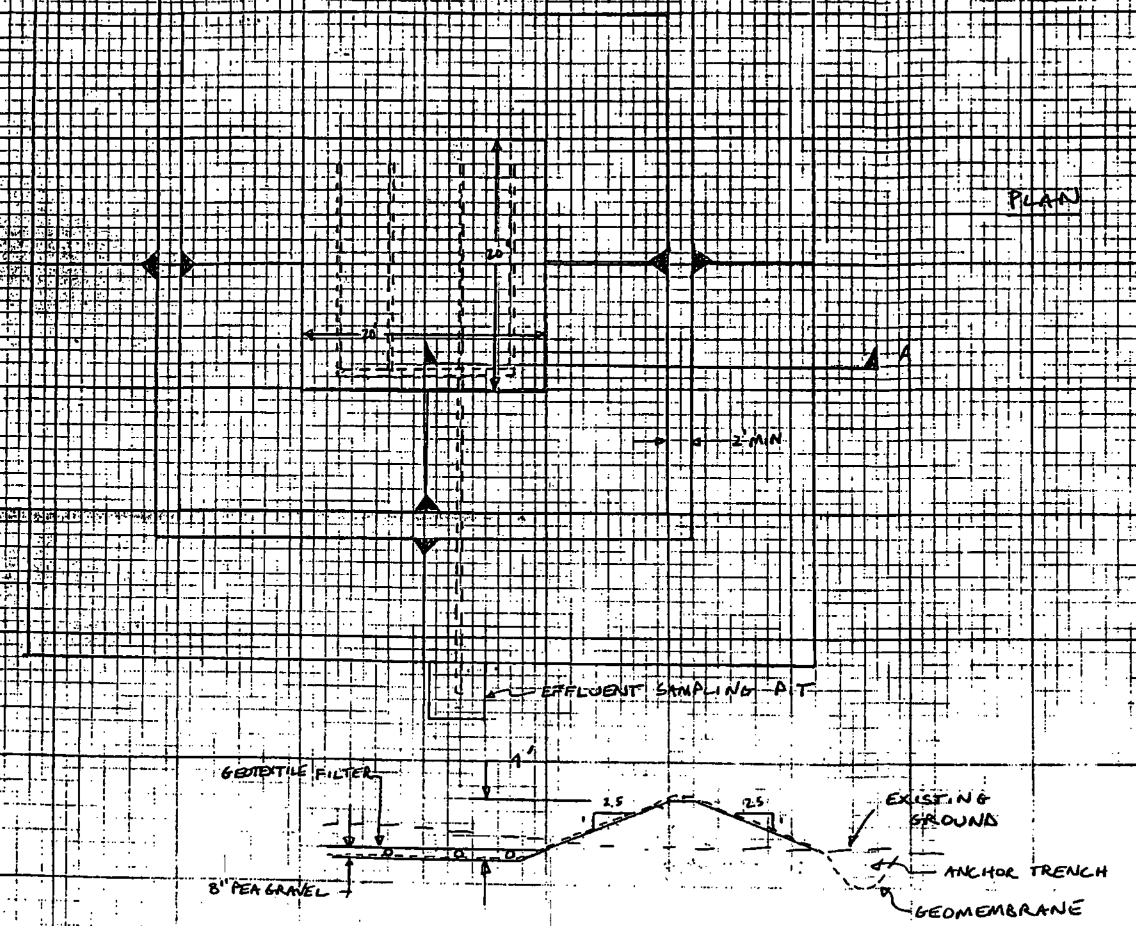
Consulting Engineers, Architects and Planners

BY ACJ DATE ______ SHEET NO. ______ OF ______

CHKD. BY ______ DATE ______ JOB NO. ______

SUBJECT SHALLOW EARTHFILL TEST CELL

DRAFT




SECTION A

FIGURE 1

SHALLOW EARTHFILL
TEST CELL
CONCEPTUAL DESIGN